

U.S. Appln. No. 09/707,726  
Atty. Docket No. 99-319

IN THE CLAIMS:

The following is a complete listing of the claims in this application, reflects all changes currently being made to the claims, and replaces all earlier versions and all earlier listings of the claims:

1-4. (cancelled)

5. (currently amended) ~~The method of claim 4 where:~~ A method for estimating the grade of service (GoS) and offered traffic for voice over internet protocol (VoIP) calls at a gateway bridging calls between a public switched telephone network and an internet protocol network, the gateway having a dial-control management information base, the method comprising the steps of:

periodically polling a dial-control management information base for dial peer traffic statistics;

storing the polled data;

estimating the carried traffic using the polled data;

estimating the grade of service by utilizing the Erlang-B formula in an inverse manner, operating on the estimated carried traffic obtained in the first estimating step; and

estimating the offered traffic using the estimated values for the carried traffic and the grade of service obtained in the previous estimation steps,

where the dial-control management information base is standardized as per RFC 2128, and where the dial peer traffic statistics obtained in the polling step comprise at least dialCtlPeerConnectTime and dialCtlPeerStatsSuccessCalls as defined in said standard, and

where the carried traffic is estimated using the following equation:

U.S. Appln. No. 09/707,726  
Atty. Docket No. 99-319

$$C = \sum_{i \in I} \delta(i) (CT(i,b) - CT(i,a)) / (b - a),$$

where, for each dial peer  $i$ ,  $CT(i,b)$  is the value of dialCtlPeerConnectTime for dial peer  $i$  at time  $b$ ,  $CT(i,a)$  is the value of dialCtlPeerConnectTime for dial peer  $i$  at time  $a$ , and  $\delta(i) = 1$  if dial-peer  $i$  is a dial-peer on the public switched telephone network side of the gateway,  $\delta(i) = 0$  if the dial-peer is on the internet protocol side of the gateway, and  $C$  is the summation over all dial peers, giving the total carried traffic for the gateway.

6. (original) The method of claim 5, where:

the grade of service seen by the offered traffic in the time interval  $(a,b)$  is given by grade of service = Erlang( $B, C/(1-G^*)$ ), where  $B$  is the total number of ISDN B channels on the public switched telephone network side of the gateway, Erlang() is the Erlang-B formula, and  $G^*$  is a solution of the equation  $G^* = \text{Erlang}(B, C/(1-G))$  subject to the condition that  $0 < G^* < 1$ , and the offered traffic is estimated as  $\Delta = C/(1-G^*)$  in the time interval  $(a,b)$ .

7. (original) The method of claim 5 where  $G^*$  is found using numerical methods, and the Erlang-B formula is computed using the following well-known recursion formula:

$$\text{Erlang}(B, \Delta) = \Delta \text{Erlang}(B-1, \Delta) / (B + \Delta \text{Erlang}(B-1, \Delta)),$$

with the initial condition set such that  $\text{Erlang}(0, \Delta) = 1$ .

8-11. (cancelled)

U.S. Appln. No. 09/707,726  
Atty. Docket No. 99-319

12. (currently amended) ~~The apparatus of Claim 11 where:~~ An apparatus for estimating the grade of service and offered traffic for voice over internet protocol calls at a gateway bridging calls between a public switched telephone network and an internet protocol network, where the gateway has a dial-control management information base, the apparatus comprising:

means for periodically polling the dial control of the management information base for dial peer traffic statistics;

means for storing the polled data;

a first estimating means for estimating the carried traffic using the polled data;

a second estimating means for estimating the grade of service by utilizing the Erlang-B formula in an inverse manner operating on the carried traffic result from the first estimating means;

a third estimating means for estimating the offered traffic using the estimated values for the carried traffic and the grade of service obtained by the first and second estimation means; and

means for numerical calculation for processing numerical data needed by each of the first, second and third estimation means,

where the dial-control management information base is standardized as per the standard described in the Internet Engineering Task Force (IETF) Request for Comment (RFC) 2128,

where the dial peer traffic statistics obtained by the means for polling comprise at least the dialCtlPeerConnectTime and dialCtlPeerStatsSuccessCalls as defined in said standard, and

where the carried traffic is estimated by the first estimating means using the following equation:

U.S. Appl. No. 09/707,726  
Atty. Docket No. 99-319

$$C = \sum_{i \in I} \delta(i) (CT(i,b) - CT(i,a)) / (b - a),$$

where  $CT(i,b)$  is the value of dialCtlPeerConnectTime for dial peer  $i$  at time  $b$ ,  $CT(i,a)$  is the value of dialCtlPeerConnectTime for dial peer  $i$  at time  $a$ , and  $\delta(i) = 1$  if dial-peer  $i$  is a dial-peer on the PSTN side of the gateway, and  $\delta(i) = 0$  if the dial-peer is on the IP side of the gateway, and  $I$  is the set of all dial peers at the gateway;

the estimate made by the second estimating means of the GoS seen by the offered traffic in the time interval  $(a,b)$  is given by solving the equation  $GoS = Erlang(B, C/(1-G^*))$ , wherein  $B$  is the total number of ISDN B channels on the public switched telephone network side of the gateway,  $Erlang()$  is the Erlang-B formula, and  $G^*$  is a solution of the equation  $G^* = Erlang(B, C/(1-G^*))$  subject to the condition that  $0 < G^* < 1$ , wherein said solution  $G^*$  is generated by the means for numerical calculation; and

the offered traffic is estimated by the third estimating means to be  $\Delta = C/(1-G^*)$  in the time interval  $(a,b)$ .

13. (original) The apparatus of Claim 12 where the nonlinear equation solution  $G^*$  is found by the means for numerical calculation using numerical methods, and the Erlang-B formula is computed by the means for numerical calculation using the following well known recursion formula:

$$Erlang(B,\Delta) = \Delta Erlang(B-1,\Delta) / (B + \Delta Erlang(B-1,\Delta)),$$

with the initial condition set such that  $Erlang(0,\Delta) = 1$ .

14-17. (cancelled)

U.S. Appln. No. 09/707,726  
Atty. Docket No. 99-319

18. (currently amended) ~~The computer executable code of claim 14 where:~~  
Computer executable code stored on one or more computer readable media, the code for  
estimating the grade of service and offered traffic for voice over internet protocol calls at  
a gateway bridging calls between a public switched telephone network and an internet  
protocol network, where said gateway has a dial-control management information base,  
the code comprising code to cause the performance of the steps of:

periodically polling the dial control of the management information base for dial  
peer traffic statistics;

storing the polled data;

estimating the carried traffic using the polled data;

estimating the grade of service by utilizing the Erlang-B formula in an inverse  
manner operating on the estimated carried traffic obtained in the first estimating step, and  
the number of channels on the public switched telephone network side of the gateway;  
and

estimating the offered traffic using the estimated values for the carried traffic and  
the grade of service obtained in the previous estimation steps,

where the carried traffic is estimated using the following equation:

$$C = \sum_{i \in I} \delta(i) (CT(i, b) - CT(i, a)) / (b - a),$$

where, for each dial peer i, CT(i,b) is the value of dialCtlPeerConnectTime for dial peer i at time b, CT(i,a) is the value of dialCtlPeerConnectTime for dial peer i at time a, and  $\delta(i) = 1$  if dial-peer i is a dial-peer on the public switched telephone network side of the gateway,  $\delta(i) = 0$  if the dial-peer is on the internet protocol side of the

U.S. Appln. No. 09/707,726  
Atty. Docket No. 99-319

gateway, and C is the summation over all dial peers, giving the total carried traffic for the gateway.

19. (currently amended) ~~The computer executable code of claim 14, where:~~  
Computer executable code stored on one or more computer readable media, the code for estimating the grade of service and offered traffic for voice over internet protocol calls at a gateway bridging calls between a public switched telephone network and an internet protocol network, where said gateway has a dial-control management information base, the code comprising code to cause the performance of the steps of:

periodically polling the dial control of the management information base for dial peer traffic statistics;

storing the polled data;

estimating the carried traffic using the polled data;

estimating the grade of service by utilizing the Erlang-B formula in an inverse manner operating on the estimated carried traffic obtained in the first estimating step, and the number of channels on the public switched telephone network side of the gateway;  
and

estimating the offered traffic using the estimated values for the carried traffic and the grade of service obtained in the previous estimation steps,

where the grade of service seen by the offered traffic in the time interval (a,b) is given by  $\text{grade of service} = \text{Erlang}(B, C/(1-G^*))$ , where B is the total number of ISDN B channels on the public switched telephone network side of the gateway, Erlang() is the Erlang-B formula, and  $G^*$  is a solution of the equation  $G^* = \text{Erlang}(B, C/(1-G^*))$  subject to the condition that  $0 < G^* < 1$ , and the offered traffic is estimated as  $\Delta = C/(1-G^*)$  in the time interval (a,b).

U.S. Appln. No. 09/707,726  
Atty. Docket No. 99-319

20. (currently amended) ~~The computer executable code of claim 14 where~~  
Computer executable code stored on one or more computer readable media, the code for  
estimating the grade of service and offered traffic for voice over internet protocol calls at  
a gateway bridging calls between a public switched telephone network and an internet  
protocol network, where said gateway has a dial-control management information base,  
the code comprising code to cause the performance of the steps of:

periodically polling the dial control of the management information base for dial  
peer traffic statistics;

storing the polled data;

estimating the carried traffic using the polled data;

estimating the grade of service by utilizing the Erlang-B formula in an inverse  
manner operating on the estimated carried traffic obtained in the first estimating step, and  
the number of channels on the public switched telephone network side of the gateway;  
and

estimating the offered traffic using the estimated values for the carried traffic and  
the grade of service obtained in the previous estimation steps.

where  $G^*$  is found using numerical methods, and the Erlang-B formula is  
computed using the following recursion formula:

$$\text{Erlang}(B, \Delta) = \Delta \text{Erlang}(B-1, \Delta) / (B + \Delta \text{Erlang}(B-1, \Delta)),$$

with the initial condition set such that  $\text{Erlang}(0, \Delta) = 1$ .

21-24. (cancelled)

25. (original) A system for continuously monitoring voice over internet  
protocol grade of service and offered traffic at the gateways in an internet protocol

U.S. Appln. No. 09/707,726  
Atty. Docket No. 99-319

telecom network, where said gateways have a dial-control management information base, said system comprising:

a network management system; and

a computer on which the network management system runs, where on each gateway poll the network management system:

time stamps the retrieved polled dial peer traffic statistics; and writes the raw data to a file on the computer,

where the system utilizes the method of claim 5 to estimate the voice over internet protocol grade of service and offered traffic at the gateways in the network, and provides the estimated grade of service and offered traffic as a function of time for a number of data points N throughout the day, where N is  $24/T$ , where T is the period of polling, in hours, for dial peer traffic statistics.

26. (original) A system for continuously monitoring voice over internet protocol grade of service and offered traffic at the gateways in an internet protocol telecom network, where said gateways have a dial-control management information base, said system comprising:

a network management system; and

a computer on which the network management system runs, where on each gateway poll the network management system:

time stamps the retrieved polled dial peer traffic statistics; and writes the raw data to a file on the computer,

where the system utilizes the method of claim 6 to estimate the voice over internet protocol grade of service and offered traffic at the gateways in the network, and provides the estimated grade of service and offered traffic as a function of time for a number of



U.S. Appln. No. 09/707,726  
Atty. Docket No. 99-319

data points  $N$  throughout the day, where  $N$  is  $24/T$ , where  $T$  is the period of polling, in hours, for dial peer traffic statistics.

27. (original) A system for continuously monitoring voice over internet protocol grade of service and offered traffic at the gateways in an internet protocol telecom network, where said gateways have a dial-control management information base, said system comprising:

a network management system; and

a computer on which the network management system runs, where on each gateway poll the network management system:

time stamps the retrieved polled dial peer traffic statistics; and writes the raw data to a file on the computer,

where the system utilizes the method of claim 7 to estimate the voice over internet protocol grade of service and offered traffic at the gateways in the network, and provides the estimated grade of service and offered traffic as a function of time for a number of data points  $N$  throughout the day, where  $N$  is  $24/T$ , where  $T$  is the period of polling, in hours, for dial peer traffic statistics.

28. (currently amended) The system of any of claims ~~24~~ 25-27, where there is additionally provided a web page interface where the reports on gateway measures as a function of time of day can be disseminated.

29. (cancelled)